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ABSTRACT

A common weakness characteristic of many instructional programs is that little advance planning is devoted to evaluation. The first stage of formulating and operationalizing an evaluation plan for the Iowa-Undergraduate Pre-Service Science Teacher Education Program (Iowa-UPSTEP) was to locate two external evaluators possessing experience and interest in teacher education. During the three-month orientation, the evaluators had informal discussions with faculty, staff, graduate students, and UPSTEP students. Near the end of the reflective stage, a project meeting of the UPSTEP directors, faculty, and evaluators attempted to formulate questions that would be worthwhile to the program and granting agency. Both institutional and accountability questions were to be evaluated; therefore, a responsive evaluation procedure was agreed upon. The data collected from students, staff, and graduates were then interpreted in terms of the following UPSTEP issues: (1) field experiences; (2) interpersonal relationships; (3) development of personal goals for science teaching; (4) instructional modules; (5) survival skills; (6) university-field integration; (7) educational psychology and secondary education; (8) senior leadership seminar: an alternative to the summer workshop; (9) career education cooperative work program; (10) curriculum development; and (11) field input. The reflective-responsive evaluation resulted in some specific findings and recommendations regarding Iowa-UPSTEP. Recommendations for 9 of the 11 issues are outlined in detail. (JMK)

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REFLECTIVE-RESPONSIVE EVALUATION TECHNIQUES FOR UNDERGRADUATE PRE-SERVICE SCIENCE TEACHER EDUCATION PROGRAMS

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Introduction

Program evaluation has historically been fraught with controversy and weaknesses. Many of the concerns involved lack of advance planning of the program evaluation which resulted in little evaluation being done, rather than the best that the situation would allow. It is generally agreed that evaluation should attempt to collect valid, reliable, relevant, sufficient, and adequate data on which to base descriptions and value judgments (Stuffebeam, 1973; and Cranton and Legge, 1978). The application and operationalization of such a construct becomes somewhat more difficult. Scriven (1967) suggested consideration of a two-dimensional matrix of formative-summative and internal-external evaluation as helpful when evaluating programs.

Figure 1: Scriven's Evaluation Matrix

	Formative	Summative
Internal		
External		

Formative program evaluation normally attends to problems during the development and evolution of a program and can be carried out by either internal or external evaluators or agents, while summative evaluation relates to problems of a completed program. Again, external or internal agents could be employed. Cranton and Legge (1978) suggested that internal agents with comprehensive knowledge of the program might provide an evaluation that is biased. Further Cranton and Legge suggested the addition of a third dimension to Scriven's

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evaluation scheme which considers whether the evaluation is intended for institutional or accountability purposes. They believe that the institutional inhouse questions can be fulfilled by internal-formative evaluation while external-summative evaluation best fulfills the accountability purpose.

The use of a mutually exclusive, multi-stage, binary evaluation approach as outlined by Cranton and Legge can be questioned, as most practical evaluation questions do not have a single focus but rather several foci. Infrequently do summative program evaluations focus exclusively on a go, no-go issue, but rather focus on whether a program should be continued and, if so, in a what form. Therefore, most program evaluations have formative and summative responsibilities. Likewise the institutional-accountability dimension becomes cloudy. The use of external or internal agents is not always clear, for many evaluation questions require insights based on comprehensive program knowledge not possessed by external agents. The use of external agents in these cases will require time and energy to accumulate the knowledge; and, during such assimilation processes, the external agent may be assimilated by the internal agency.

Stake (1976) suggested that program evaluation techniques should concentrate on making observations and interpreting the data rather than planning the observation. He believes responsive evaluation is designed to emphasize educational issues, program participation, pluralism of value standards, and continuous audience needs, where preordinate evaluation emphasizes formal goals, standardized tests, uni-standard values, and formal research reports. Stake states:

> For example, when a particular critical issue has already been identified, when certain criterion variables have already been heralded, when the critics of the program are highly emotional, when the time for a specific decision about the program

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> is looming, when the search is more for proof than understanding (p. 20)

then responsive evaluation may be inappropriate; but if the program health is to be fully examined, then responsive evaluation is appropriate.

Regarding the issue of external or internal evaluators, Stake (1976) suggested that if program evaluation is to solve problems then the people closest to the problem will likely have the dedication to carry out the solutions. External evaluators will sometimes provide new insights, experiences, and understandings that will result in solutions not apparent to internal agents.

The purpose of this paper is to outline a reflective-responsive evaluation approach applied to the assessment of a program in science teacher education. The reflective phase was graphed on to Stake's repsonsive approach to allow the evaluation plans to benefit from the program's history and the evaluators to gain program knowledge and sensitivity.

Problem

The increased pressure from teacher groups, governmental agencies, and other sources to relocate the authority and responsibility for teacher education clearly necessitates the evaluation of existing programs. No longer can the existence of present programs be justified on traditional grounds; rather energies must be applied to collect information from which the state of the art can be described, logical professional discussions can be based, and educational decisions can be made. Program evaluation techniques need to be developed and applied that will consider the dynamic nature of science teacher education of the 1970s. A variety of evaluation and statistical considerations had to be incorporated into the procedures in order to establish a reasonable degree of validity and reliability while maintaining the reflective-responsive

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nature to capture an accurate image of the programs.

Reflective Stage

A common weakness characteristic of many instructional programs is that little advance planning is devoted to evaluation. This is especially true of programs that have been in existence for some time and have been justified on traditional grounds. The Iowa-Undergraduate Pre-Service Science Teacher Education Program (Iowa-UPSTEP) had not operationalized a thorough evaluation plan, even though accountability to the funding agency was planned. The first stage of formulating and operationalizing an evaluation plan was to locate two external evaluators possessing experience and interest in teacher education. A period of time (three months) was set aside to allow the evaluators to get oriented with the institution, staff, history, students, resources, objectives, and present program. The basic assumption that the evaluation procedure must reflect the unique attributes of the specific program being evaluated dictated that the orientation phase be comprehensive.

Iowa-UPSTEP is an NSF-funded program that has evolved since its conception in 1970. It is part of a large academic institution in which secondary teacher education plays a minor role and has attempted to fulfill a dynamic set of needs within these constraints. Both the academic and market climate have varied over the development period; therefore, the evolution of the program has been redirected at times.

During the orientation, evaluators had informal discussions with faculty, staff, graduate students, and UPSTEP students. They also participated in classes and made direct observations of faculty and graduate student teaching and UPSTEP students involved in clinical practica and student teaching. The evaluators

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also assessed data sources maintained as part of the program, availability of UPSTEP graduates, and sketched out problem foci within these limitations.

Near the end of the reflective stage, a project meeting of the UPSTEP directors, faculty, and evaluators attempted to formulate questions that would be worthwhile to the program and granting agency. It was apparent at this meeting that both institutional and accountability questions were to be evaluated, therefore a responsive evaluation procedure was agreed upon. The early discussions revealed that Iowa-UPSTEP was far from being complete, even though external funding was nearing the end. Tentative plans for the program appeared to indicate redirection to meet new and consolidate older positions.

Responsive Stage

Stake (1976) outlined a set of non-sequential tasks to be considered in responsive evaluation. These tasks (Table 1) served as a guide for the establishment of the UPSTEP evaluation. Some of these tasks occurred during the reflective stage and were further developed during the responsive stage.

Table 1: Stake's Theoretical Statement Regarding Responsive Evaluation

Identify program scope	Overview program activities	Discover purposes, concerns	Conceptualize issues, problems
Identify data needs, re issues	Select observers, judges, instruments, if any	Observe designated antecedents, transactions and outcomes	Thematize: prepare portrayals, case studies
Winnow, match issues to audience	Format for audience use	Assemble formal reports, if any	Talk with clients, program staff, audiences

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A close search of Iowa-UPSTEP historical documents revealed that, rather than evaluating a single program, several programs were being evaluated. Since the program evolved in response to several sets of needs, objectives, and people, Iowa-UPSTEP graduates were exposed to different instructional components for varying periods of time. Therefore, the evaluators decided to collect data on each graduating class; 1970, 71, 72, 73, 74, 75, 76, 77, and 78.

Several standardized tests had been administered to students during their UPSTEP experience, so a terminal measure of these tests were planned. Other standardized measures were administered to the graduating class to provide descriptive data and references for further evaluation. A new observation form was developed for student teaching and applied to the graduating class. Anonymous copies of these observations were included for descriptive and reference purposes.

Support staff such as graduate assistants and cooperating teachers were interviewed or they administered the Science Teachers' Education Assessment Inventory (Tamir, Yager, Lunetta, 1977) to assess their opinions regarding aspects of the UPSTEP program.

Operationalizing these plans directed the evaluators toward a descriptive report since relatively small numbers of past graduates could be located, and the comparison groups were not equivalent samples. A personal interview was arranged with past graduates who agreed to be interviewed. A standardized protocol was developed, and the graduates were sent a copy in advance of the telephone call or personal interview. The evaluators believed the personal interview would get a large portion of graduates responding and the responses would be clearer and more comprehensive. Upon the completion of the personal interviews, it was apparent that the plan to retain graduating year identity was impossible because of small numbers; thus year of graduation identity was

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retained on individual comments but generally information was pooled across graduates of the years: 1975-77. The 1978 graduates were interviewed in person using the same protocol.

The data collected from students, staff, and graduates were then interpreted in terms of the following UPSTEP issues:

1. Field experiences
2. Interpersonal relationships
3. Development of personal goals for science teaching
4. Instructional modules
5. Survival skills
6. University-field integration
7. Educational psychology and secondary education
8. Senior Leadership Seminar: An Alternative to the Summer Workshop
9. Career education cooperative work program
10. Curriculum development
11. Field input

A variety of other issues could have been considered, but the data base and the limitations of the evaluators prevented them from being considered. Each of the above issues were discussed in light of the data collected. Possible solutions were outlined and, where possible, these solutions were initiated by the evaluators.

The final evaluation report (Novich and Yore, 1979) provides cumulative history of Iowa-UPSTEP, collected documents, raw data, and recommendations. The reflective-responsive evaluation resulted in some specific findings and recommendations regarding Iowa-UPSTEP.

1. Field Experiences

The early, varied, and extensive field experiences of Iowa-UPSTEP seems

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to be the program's strongest and most unique attribute. Several refinements may increase their effectiveness: placement procedures need to assure 1) that each intern encounters diverse teaching models; 2) UPSTEP needs to enlist the help of a cadre of supportive and illustrative cooperating teachers; and 3) the time schedule needs reorganization so that each clinical experience falls early in the term. If additional clincial experiences become feasable, an experience with retarded children, in cooperation with the University Hospital School, should be considered.

2. Interpersonal Relationships

The positive rapport between UPSTEP staff and interns is a characteristic too often missing in academic institutions. It is encouraging to note that interns have developed a similar rapport in their classrooms. Informal discussion, generally open office doors, and casual socials could be continued and facilitated whenever possible.

3. Development of Personal Goals for Science Teaching

A distinct thread woven through the fiber of Iowa-UPSTEP is the effort to encourage and facilitate the development by interns of their own personal goals for science instruction. Although this effort may not win immediate acceptance, it is valued by the interns later. Several factors appear to contribute to this success: 1) the exposure to various strategies, grade levels, type of students; 2) significant concern for this issue across courses, including the History and Philosophy of Science component of the program. The History and Philosophy of Science courses could have greater impact if they were to explore practical classroom applications of the content, ideas, and processes.

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4. Instructional Modules

The data indicated that certain modules were consistently valued by UPSTEP graduates, i.e, "Developing a Self-Instructional Module" and "Assessing Students' Intellectual Development". Continued revision of existing modules needs to be encouraged to bring other UPSTEP modules to similar levels of acceptance.

5. Survival Skills

Summary observation reports by student teaching supervisors, together with interview responses of UPSTEP graduates, strongly indicate a need to strengthen the UPSTEP program in the general area of large-group teaching, which is the predominant instructional mode of student teachers and recent graduates. Consideration should be given to the following areas:

a. Group questioning skills and discussion strategies,

b. Group strategies - pre-lab, lab, post-lab.

c. Classroom management-discipline.

d. Audiovisual machine skills.

e. Selection and adaptation of widely used curriculum programs and materials.

f. Practical evaluation techniques.

6. University-Field Integration

UPSTEP graduates value the contributions made by the field experiences significantly more than any other component of the program; likewise, they value the contribution made by the cooperating teachers more highly than the university professors and significantly more than the university supervisors. Informal observations indicate that the student teaching

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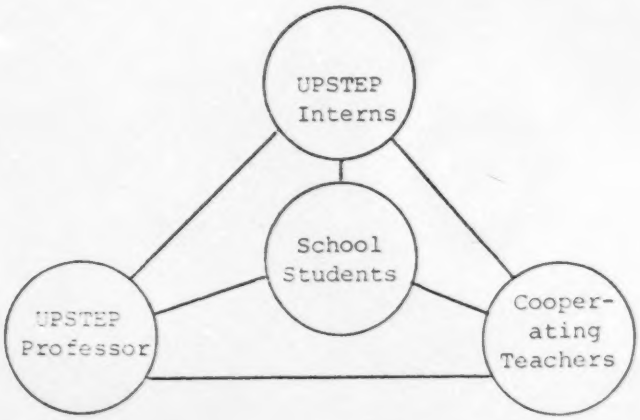
field experience involves minimal professorial time commitment. Interview responses also indicate that the university supervisor's role, other than as an evaluator, is generally perceived to be a minor one. In view of these observations, it appears that Iowa-UPSTEP should take steps to clarify the roles and responsibilities of the field experience supervisors. The following suggestions are proposed for consideration:

a. The university-based UPSTEP activities need to more accurately reflect the realities of today's public schools, while striving to change them.

b. The identification, selection, development, and reward of a cadre of diverse and effective cooperating teachers is needed to increase the effectiveness and compatibility of clinical experiences placements.

c. UPSTEP needs to allocate more professorial time to direct supervision of the field experiences. Ideally the role of university supervisor should be eliminated and the duties reallocated to the university professor and cooperating teacher, thus simplifying the player model to:



The simpler model would have fewer and shorter lines of communications, thus improving the integration and rapport between university and field. Closer association with the field experience would facilitate meaningful

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follow-up and sharing of experiences.

7. Senior Leadership Seminar: An Alternative to the Summer Workshop

The summer workshops of 1973, 1974, and 1975 were highly valued by participating UPSTEP graduates. The workshops' goals, conceptualization, and operation provided a healthy bridge between the reality of teaching and university experiences. The present situation regarding funding appears to suggest that the workshop may never be able to be reactivated in its original form. A meaningful alternative, a Senior Leadership Seminar, could be a viable substitute.

The Leadership Seminar would be directed at real problems facing local school districts and be an option for UPSTEP interns who complete student teaching with at least an A- average. Such a seminar could be developed around a team consisting of three to four interns, an equal number of cooperating teachers, and an UPSTEP professor. Such a group would allow the formation of intern-cooperating teacher pairs to attack specific problems. Such a pairing will provide flexibility in covering classes and various team roles. It is likely that in return for consultation by the UPSTEP professor and input by the interns, school districts would be willing to fund some release time for participating cooperating teachers.

8. Careers Education Cooperative Work Program: An Alternative to Educational and Scientific Research

The 1975 proposed UPSTEP model suggested the inclusion of educational and scientific research components that have not been experienced thus far by the majority of UPSTEP graduates. The academic demands necessary to achieve such goals, when weighed against the payoff, appear to be questionable.

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A future direction for UPSTEP evolution might be to develop a careers-in-science component as an alternative to the research component. The payoff of such an experience would be science teachers who are better informed regarding the numerous science-related careers open to their students. A potential for developing a cooperative summer work program with local industries involved in varied science-related production exists in eastern Iowa, e.g., food, electronics, meat processing, air transportation.

9. Field Input

It is suggested that future modifications and evaluations of UPSTEP should involve input from science teachers in the field. This effort can be facilitated through cooperation with Iowa-Assist. Since teacher education is a professional responsibility, Iowa-UPSTEP could take a leading role in maximizing professional input into the development of teacher education programs.

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